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NOTES ON OCEANOGRAPHY.

BY

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THE GERMAN DEEP SEA EXPEDITION.—In the *Zeitschrift der Gesellschaft für Erdkunde* (Berlin), Vol. XXXIV, No. 2, pp. 75 to 183, will be found the full report of this interesting and successful expedition.

The first sixty pages are devoted to the report of the leader of the expedition, Professor Dr. Chun, and are composed of reports upon the various localities visited, giving general descriptions of each as forwarded from time to time during the trip. These contain discussions of the soundings, temperatures, chemical and biological phenomena, and the physical conditions.

This is followed by the report of Dr. Gerhard Schott, the Oceanographer, which deals with the scientific equipment, meteorology, soundings, temperatures, ice conditions, etc.

The third section of the report is an account of the rediscovery of Bouvet Island, by the navigator of the expedition, Captain Walter Sachse.

Five charts accompany the report, all of which might be considered as preliminary to a full discussion of the results which will follow later.

The principal results of the expedition have been summarized by Dr. Supan in *Petermanns Mitteilungen*,* as follows:

1. The rediscovery of Bouvet Island and the determination of its exact position. This island was discovered by Bouvet in 1739, and seen again by Lindsay in 1808, and by Norris in 1825. Its location is in Lat. $54^{\circ} 28'$ S. and Long. $3^{\circ} 24'$ E. In extent it covers about $9\frac{1}{2}$ kilometres from east to west, and about 8 kilometres from north to south. It is a volcanic mountain, whose northerly side reaches an elevation of 935 metres. It is entirely covered with ice, which extends to the sea-level and forms a precipice at this point. These observations make this island one of the outposts of the Antarctic, a character which is confirmed by the temperature observations. No traces of vegetation were visible through the

* *Petermanns Mitteilungen*, Vol. 45, No. 4, p. 94.

telescope, and animal life seems very scanty. Nothing positive was determined about the position of Thompson Island.

2. Enderby Land was not reached, since the course of the ship was directed to the northward at Lat. 64° S., but samples of the bottom seem to give strong evidence that it is not volcanic in its character. Along the border of the pack ice the sea bottom was covered with diatomaceous earth; the nearer Enderby Land was approached, a layer of clay became more and more apparent. At a point in Lat. $63^{\circ} 17'$ S. and Long. $57^{\circ} 51'$ E. "ground moraine" material was found, which had doubtless been carried to sea by icebergs. It consisted of granite, gneiss, schists, and a considerable block of red sandstone.

3. Climate. The zone of brisk west winds, accompanied by a low barometer, extends to Lat. 55° S. south of Africa, and to $56^{\circ} 30'$ S. south of Kerguelen Island. From this point to 60° S. a zone of calms is found, with changeable winds; while beyond 60° S. easterly winds prevail. In the other portions of the Antarctic Ocean the westerly winds prevail to a point further south, *i. e.*, to 60° and even 64° S.

The conclusion can therefore be drawn from these facts, that the Antarctic Anticyclone is not located around the Pole, but that it occupies a portion of the westerly Indian Ocean.

The boundary of the drift ice was first reached in November, 1898, in Lat. $56^{\circ} 45'$ S. and Long. 7° E. On the journey from the most southerly point reached in the neighborhood of Enderby Land no icebergs were met north of Lat. $61^{\circ} 22'$ S.

4. Oceanography.

One of the chief services rendered by the Valdivia Expedition consists in the numerous soundings which were made and which established the existence of an extended deep-sea region. Heretofore it has been taken for granted that the bottom of the eastern Atlantic Ocean and the western half of the Indian Ocean decreased in depth rapidly toward the south. It is, however, probable that these basins extend far into the Antarctic area. Kerguelen, Crozet Island, and the Prince Edward Islands were considered the outer border of a supposed Antarctic plateau, and this idea had so far gained ground that Von Haardt (1895) and Fricker (1898) simply ignored the soundings of the *Challenger* in their charts. The *Challenger's* work had already furnished the proof that the Southern Indian Ocean between Long. 80° and 95° East, and between Lat. 60° and 66° South, was over 3,000 metres deep. In the region investi-

gated by the *Valdivia* between Long. 7° and 53° East, the bottom lies below the isobathic line of 5,000 metres.

The temperatures at the bottom of the ocean, south of the 56° parallel, were all negative with a single exception, but none were lower than 0.5° C. The temperature series in 63° S. and 54° E. gave, for December, the following layers:

1. A surface layer of 120 metres in thickness, with negative temperature to -1.7° C.;
2. An intermediate layer of about 2,200 metres thickness, with positive temperature $+1.7^{\circ}$ C.;
3. A similar or even greater lower layer with negative temperatures, which however, as has already been stated, do not sink below 0.5° C.

The temperature decreases from the surface to a depth of 80 metres, then increases to about 1,200 metres, after which it again decreases to the bottom. The same stratification or distribution into layers is found further to the westward, only the water in this region is somewhat colder. Similarly towards the east over the *Challenger* route, but here the cold surface layer reaches to the bottom, 3,000 to 3,300 metres, and the cold layer is only found in depths below 3,600 metres.

The lowest temperature obtained by the *Challenger* was -1.7° C., and the highest was only $+1.1^{\circ}$ C. It appears, therefore, that the sea in the neighborhood of Enderby Land is favored with a slightly warmer temperature, and it would seem natural to connect this condition with the possible prolongation of the warm Kerguelen temperature. Further temperature observations south of Kerguelen Island would settle this point.

5. Marine Bio-geography.

The plankton seems to increase to a depth of about 2,000 metres, then decreases rapidly, but none of the layers is entirely wanting in forms of life. On the other hand, the plankton vegetation reaches its lower boundary between 300 and 400 metres. The peculiarity of the Antarctic plankton consists in the tremendous development of the diatoms, and in the presence of many specific forms, as far south as Lat. 40° , but even at 50° S. forms characteristic of warmer seas are found mixed with them.

GREAT FISH BAY.—This bay, investigated by Professor Chun during the stay of the *Valdivia* from October 10th to 12th, has a width of from four to five nautical miles and a length of about twenty.*

* Annalen der Hydrographie und Maritimen Meteorologie. March 1899, p. 100.

It was formerly supposed to be comparatively shallow, but appears to have sufficient depth for even the largest ships. There is no bar across its mouth, which is quite open and has a depth of about 18 fathoms at distance of a mile from the Tiger Peninsula. It is the largest and best harbor on the west coast of Africa, although the Tiger Peninsula is nothing but a sandy point of slight height, and the mainland consists of a series of constantly shifting sand hills.

The first impression produced by the bay is that of terrible desolation. It, however, turns out to be the home of many species of useful fishes and marine animals.

The *Valdivia* visited this bay about the time of the spawning season, apparently, and this may account for the abundance of these life forms. The southern herring was very plentiful, as well as some seven other edible species. This richness in living forms is probably due to the astonishingly favorable conditions of the relatively cooler water. The plankton was very rich, as was also the bottom fauna; while the birds, as a natural consequence, were very numerous.

Sweet water is absolutely wanting in this region, since no river empties into the bay. The salinity of the water is therefore the same as in the open ocean close at hand (35.4). The temperature of the surface varies from 15.5° to 16.5° C., and at the mean depth of the bay (20 metres) the temperature is 14.1° C.

The color of the water is a blackish green, and it is not transparent, owing to the amount of suspended matter, both dead and alive, and this color is perceptible for a distance of 100 nautical miles from the coast.

THE DETERMINATION OF LOW WATER IN THE GULF OF ST. LAWRENCE.—The work of Mr. W. B. Dawson is summarized in the *Annalen der Hydrographie und Maritimen Meteorologie* for March, 1899, p. 120, and the principal results are given for the more important ports, such as St. Johns, Halifax, and Quebec.

METEOROLOGIA ED OCEANOGRAPHIA.—A review of a work upon this subject by Edoardo Mazelle appears in a recent number of the *Annalen**.

The book was prepared at the request of the Director of the Royal Hungarian Nautical Academy at Fiume. It is intended not only as a text-book for the students, but as a hand-book for the sea

* *Annalen der Hydrographie und Maritimen Meteorologie*, March, 1899, p. 122.

captains of the Hungarian commercial fleet. It therefore goes into much detail, while keeping in mind that it is a general introduction to the subject. The treatment naturally falls under the two main heads of Meteorology and Oceanography, while there is a third or practical portion devoted to the application of both sciences to navigation. The contents of the work are well arranged and thoroughly treated in an easily understood style. It is well illustrated with woodcuts, showing the meteorological conditions of the atmosphere, and the tides and currents of the ocean, as well as the various meteorological and oceanographical instruments.

The author lays particular stress upon the necessity for continuous meteorological observations at sea, in order to meet the exceptional conditions not provided for by the sailing directions, which only cover general cases. It thus teaches the ship's master to reason out logically his own set of conditions, instead of depending upon "rule of thumb" methods.

The third section deals with "sailing directions, wind and current charts" and "ocean lanes." It closes with a description of the forms of records and the methods of keeping them correctly.

Tables for the reduction of the barometer are given, also two charts which make no pretension to completeness and give but an outline in the one case of the ocean pathways, and in the other of the ocean currents. These charts might have been improved to advantage, as they are not in keeping with the high character of the book.

The *Annalen* expresses its regret that the linguistic relations in the Hungarian, as in the Austrian, commercial marine, did not permit the issue of the work in German.